CLAIMS

1. A method for electronic activation of a driver device of at least one ultrasonic piezoelectric actuator from a control computer that is provided with a DC-to-AC step-up voltage converter supplied by a DC voltage source (B), the high-voltage output of which is connected to an oscillating circuit composed of the actuator (l_i) and a resonance inductor (L), the said converter being composed of a circuit having at least one transformer with at least one primary winding connected to the voltage source by at least one drivable switch and a single secondary winding delivering an AC signal for excitation of the piezoelectric actuator, and such that the voltage (V_c) at the terminals of the load composed of the transformer, resonance inductor and actuator is a square-wave signal of specified chopping frequency (f_r), characterized in that the current (I_c) flowing in the load is a periodic signal of resonance frequency (f_o) such that the chopping frequency (f_r) is smaller than twice the resonance frequency, such that it activates zero-current closing of the switches in the circuit, this hypo-discontinuous type of mode of activation of the switches being obtained from the transformation ratio of the transformer and of the resonance inductor determined as a function of the equivalent capacitance of the actuator.

2. A method for electronic activation of the driver device of at least one ultrasonic piezoelectric actuator from a control computer that is provided with a DC-to-AC step-up voltage converter supplied by a DC voltage source, the high-voltage output of which is connected to an oscillating circuit composed of the actuator and a resonance inductor, the said converter being composed of a circuit having at least one transformer with at least one primary winding connected to the voltage source by at least one drivable switch and a single secondary winding delivering an AC signal for excitation of the piezoelectric actuator, which method is characterized in that:

- the voltage (V_c) at the terminals of the load composed of the transformer, resonance inductor and actuator is a square-wave signal of specified chopping frequency (f_r),

- the current (I_c) flowing in the load is a periodic signal whose phase is advanced relative to the voltage (V_c) and whose resonance frequency (f_o) is such that the chopping frequency (f_r) lies between half and twice the resonance frequency, ($f_o/2 < fr < 2\ f_0$), in such a way that it activates zero-current closing of the switches in the driver switch, this hypo-continuous type of mode of activation of the switches

being obtained from the transformation ratio of the transformer and of the resonance inductor determined as a function of the equivalent capacitance of the actuator.

3. A method for electronic activation of the driver device of at least one ultrasonic piezoelectric actuator from a control computer that is provided with a DC-to-AC step-up voltage converter supplied by a DC voltage source, the high-voltage output of which is connected to an oscillating circuit composed of the actuator and a resonance inductor, the said converter being composed of a circuit having at least one transformer with at least one primary winding connected to the voltage source by at least one drivable switch and a single secondary winding delivering an AC signal for excitation of the piezoelectric actuator, which method is characterized in that:

- the voltage (V_c) at the terminals of the load composed of the transformer, resonance inductor and actuator is a square-wave signal of specified chopping frequency (f_r),

- the current (I_c) flowing in the load is a periodic signal whose phase is retarded relative to the voltage (V_c) and whose resonance frequency (f_o) is such that the chopping frequency (f_r) is greater than half the resonance frequency, ($f_r > f_o/2$), in such a way that it activates zero-voltage closing of the switches at the terminals of the driver switch, this hyper-continuous type of mode of activation of the switches being obtained from the transformation ratio of the transformer and of the resonance inductor determined as a function of the equivalent capacitance of the actuator.

4. A method for electronic activation of the driver device of at least one ultrasonic piezoelectric actuator, provided with a converter composed of a bridge circuit containing at least one transformer having at least one primary winding, established from a first arm composed of two alternately drivable bridge switches (T_1, T_2) in series and of at least one second arm in parallel with the first arm and also composed of two alternately drivable bridge switches (T_2, T_3) in series, the center point of the second arm being connected to the center point of the first arm by a load composed of the transformer, resonance inductor (L) and piezoelectric actuator according to claim 1, characterized in that the sequencing of activation of the four switches of the converter is as follows:

during a first phase:

- at the instant (t_0), a first transistor (T_1) of the first arm and a second switch (T_2) of the second arm constituting a first pair are driven to closed position when the current (I_c) is zero in the diodes (D_1 and D_4) in antiparallel;

- between the instants (t_0 and t_1), the transistors (T_1 and T_4) of the first pair are closed to allow a current (I_c) to flow, while the diodes (D_1 and D_4) are nonconducting and the second transistor (T_2) of the first arm and the first transistor (T_3) of the second arm constituting a second pair are open;

- at the instant (t_1), the current (I_c) is inverted, the two diodes (D_1 and D_4) become conducting and the two transistors (T_1 and T_4) of the first pair are driven to open position between this instant (t_1) and the instant (t_2), at which the diodes (D_1 and D_4) are no longer conducting, the current dropping to zero;

during a second phase:

- at the instant (t_3), the transistors (T_2 and T_3) of the second pair are driven to closed position when the current (I_c) is zero in the diodes (D_2 and D_3) in antiparallel;

- between the instants (t_3 and t_4), these transistors (T_2 and T_3) are closed to allow the current (I_c) to flow, while the diodes (D_2 and D_3) are nonconducting and the transistors (T_1 and T_4) of the first pair are open;

- at the instant (t_4), the current (I_c) is inverted, the two diodes (D_2 and D_3) become conducting and the two transistors (T_2 and T_3) are driven to open position between this instant (t_4) and the instant (t_5), at which the diodes are no longer conducting, the current again dropping to zero,

these two phases being repeated a specified number of times during the period of operation of the actuator to generate a high-voltage, high-frequency signal on the piezoelectric actuator from the DC voltage source.

5. A method for electronic activation of the driver device of at least one ultrasonic piezoelectric actuator, provided with a converter composed of a bridge circuit containing at least one transformer having at least one primary winding, established from a first arm composed of two alternately drivable bridge switches (T_1, T_2) in series and of at least one second arm in parallel with the first arm and also composed of two alternately drivable bridge switches (T_2, T_3) in series, the center point of the second arm being connected to the center point of the first arm by a load composed of the transformer, resonance inductor (L) and piezoelectric actuator according to claim 2, characterized in that the sequencing of activation of the four switches of the converter is as follows:

during a first phase:

- at the instant (t_0), a first transistor (T_1) of the first arm and a second switch (T_4) of the second arm constituting a first pair are driven to closed position when the current (I_c) is zero in the diodes (D_1 and D_4) in antiparallel and while the other diodes (D_2 and D_3) in antiparallel of the second transistor (T_2) of the first arm and of the first transistor (T_3) of the second arm are conducting;

- between the instants (t_0 and t_1), the transistors (T_1 and T_4) of the first pair are closed to allow the current (I_c) to flow, while the four diodes (D_1 to D_4) are nonconducting;

- at the instant (t_1), the current (I_c) is inverted, the two diodes (D_1 and D_4) become conducting and the two transistors (T_1 and T_4) are driven to open position between this instant (t_1) and the instant (t_2), at which no current is present in these two transistors;

- at this same instant (t_2), the transistors (T_2 and T_3) of the second pair are driven to closed position while the diodes (D_1 and D_4) are still conducting. At this instant of closing, the diodes (D_1 and D_4) are naturally nonconducting and the current I_c flows in the same sense;

- between the instants (t_3 and t_4), the current (I_c) is inverted and the diodes (D_2 and D_3) become conducting and these transistors (T_2 and T_3) are driven to open position while there is no longer any current (I_c) present in these transistors;

- at the instant (t_4), the two transistors (T_1 and T_4) are driven to closed position, the two diodes (D_2 and D_3) become nonconducting and activation recommences according to the same sequencing as between the instants (t_0 and t_4).

6. A method for electronic activation of the driver device of at least one ultrasonic piezoelectric actuator, provided with a converter composed of a bridge circuit containing at least one transformer having at least one primary winding, established from a first arm composed of two alternately drivable bridge switches (T_1, T_2) in series and of at least one second arm in parallel with the first arm and also composed of two alternately drivable bridge switches (T_2, T_3) in series, the center point of the second arm being connected to the center point of the first arm by a load composed of the transformer, resonance inductor (L) and piezoelectric actuator according to claim 3, characterized in that the sequencing of activation of the four switches of the converter is as follows:

during a first phase:

- between the instants (t_0 and t_1), a first transistor (T_1) of the first arm and a second switch (T_4) of the second arm constituting a first pair are driven to closed position when the two diodes (D_1 and D_2) in antiparallel and the other diodes (D_2 and

D_3) in antiparallel of the second transistor (T_2) of the first arm and of the first transistor (T_3) of the second arm are nonconducting and the two transistors (T_2 and T_3) are open;

- at the instant (t1), the diodes (D_1 and D_4) of the first pair of transistors are nonconducting;

- between the instants (t_1 and t_2), the two transistors (T_1 and T_4) of the first pair are still closed, allowing the current (I_c) to flow;

- at the instant (t_2), the transistors (T_1 and T_4) of the first pair are driven to open position, the diodes (D_2 and D_3) in antiparallel of the second pair of transistors become conducting and voltage is no longer present at the terminals of the transistors (T_2 and T_3), the diodes (D_1 and D_4) being nonconducting;

- between the instants (t_2 and t_3), the transistors (T_2 and T_3) of the second pair are driven to closed position, after which they are driven to open position at the instant (t_4).

7. A method for electronic activation of a driver device of at least one ultrasonic piezoelectric actuator according to one of claims 1 to 6, characterized in that it combines, in time, the three modes of activation of the switches, or in other words the hypo-discontinuous, hypo-continuous and hyper-continuous types, as a function of the battery voltage E, which can vary, and of the peak setpoint voltage of the activation signal of the piezoelectric actuators.